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CASE REPORT

Single-stage management of a longitudinal root fracture associated with extensive bone resorption in the esthetic zone: a case report of immediate implant placement, guided bone regeneration, and immediate provisionalization

RELATO DE CASO

Manejo em estágio único de uma fratura radicular longitudinal associada à extensa reabsorção óssea na zona estética: relato de caso de instalação imediata de implante, regeneração óssea guiada e provisionalização imediata

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Abstract

Keywords: Dental implants;
Bone regeneration;
Immediate dental implant
loading.

Longitudinal fractures in endodontically treated teeth, especially after trauma, often present an unfavorable prognosis, associated with pain, fistula, and bone resorption. Immediate implant placement associated with regenerative techniques and immediate loading can offer a predictable solution for esthetic and functional restoration. Case report: A 35-year-old female patient presented with longitudinal fracture of tooth #12 with periapical lesion and fistula. Careful extraction, curettage, and socket decontamination with active oxygen gel (blue®m) were performed. A Helix Acqua GM Neodent implant (3.5 × 16 mm) with 60 N·cm insertion torque was placed, positioned 3 mm subcrestal. A universal abutment torqued at 20 N·cm was adapted, followed by placement of a provisional tooth previously milled in PMMA. The bone defect was filled with bone graft (Straumann® cerabone®) and covered with a resorbable membrane (Straumann® Jason® membrane), associated with a de-epithelialized connective tissue graft from the palate. Clinical and radiographic follow-up demonstrated fistula resolution, provisional stability, preservation of peri-implant tissues, and favorable esthetic contour. Conclusion: Single-stage treatment combining immediate implant placement, immediate loading, bone grafting, connective tissue grafting, and active oxygen gel proved to be an effective alternative for root fracture cases in the esthetic zone, providing predictable rehabilitation with satisfactory clinical and esthetic results.

Resumo

Palavras-chave:
Implantes dentários;
Regeneração óssea;
Carga imediata em
implantes dentários.

Fraturas longitudinais em dentes tratados endodonticamente, especialmente após trauma, frequentemente apresentam prognóstico desfavorável, associadas a dor, fístula e reabsorção óssea. A colocação imediata de implantes, associada a técnicas regenerativas e carga imediata, pode oferecer uma solução previsível para restauração estética e funcional. Relato de caso: Paciente do sexo feminino, 35 anos, apresentou fratura longitudinal do dente 12 com lesão periapical e fístula. Foi realizada extração cuidadosa, curetagem e descontaminação do alvéolo com gel de oxigênio ativo (blue®m). Um implante Helix Acqua GM Neodent (3,5 × 16 mm) com torque de inserção de 60 N·cm foi instalado, posicionado 3 mm subcrestalmente. Um abutment universal com torque de 20 N·cm foi adaptado, seguido da instalação de um dente provisório previamente fresado em PMMA. O defeito ósseo foi preenchido com enxerto ósseo (Straumann® cerabone®) e coberto com uma membrana reabsorvível (Straumann® Jason®), associada a um enxerto de tecido conjuntivo desepitelizado proveniente do palato. O acompanhamento clínico e radiográfico demonstrou resolução da fístula, estabilidade provisória, preservação dos tecidos peri-implantares e contorno estético favorável. Conclusão: O tratamento em estágio único, combinando a colocação imediata do implante, carga imediata, enxerto ósseo, enxerto de tecido conjuntivo e gel de oxigênio ativo, mostrou-se uma alternativa eficaz para casos de fratura radicular na zona estética, proporcionando reabilitação previsível com resultados clínicos e estéticos satisfatórios.

Introduction

Longitudinal fractures in endodontically treated teeth after trauma are relatively common outcomes, often with unfavorable prognosis, frequently associated with pain, fistula, and localized bone loss^{1,2}. In such situations, extraction with immediate implant placement emerges as a predictable alternative to preserve bone and esthetics, especially in the anterior maxillary esthetic region^{3,4,5}.

To achieve success in these cases, some factors are critical: bone availability, adequate insertion torque for immediate loading^{6,7}, three-dimensional implant positioning to promote marginal bone stability, tissue stabilization, and future prosthetic crown^{8,9,10}, decontamination of the infected site, and regeneration of the bone defect with osteoconductive biomaterials and barrier membranes^{11,12,13}.

The association of connective tissue grafts with immediate implants in the esthetic zone has shown superior results in soft-tissue stability and peri-implant esthetics^{14,15,16}. Additionally, antimicrobial adjuvants such as active oxygen gel (blue@m) have been reported as promising in controlling infection and stimulating tissue healing in periodontal and peri-implant regions^{17,18,19,20,21}.

Performing all these steps in a single surgical stage presents important advantages: reduces the number of

interventions, improves patient experience, decreases cumulative infection risks, and accelerates functional and esthetic rehabilitation^{22,23}.

Immediate provisionalization associated with bone graft and connective tissue grafts promotes soft-tissue healing and preserves gingival contour from the beginning, contributing to long-term stability^{24,25}. This integrated strategy allows not only immediate replacement of the lost tooth but also simultaneous reconstruction of hard and soft tissues, ensuring better esthetic and functional outcomes in critical areas^{9,10}.

Thus, this case aims to report a complete clinical case of longitudinal fracture with periapical lesion in a maxillary lateral incisor, treated in a single surgical stage with extraction, socket decontamination with active oxygen gel, immediate subcrestal implant placement, bone regeneration, connective tissue graft, and immediate provisionalization.

Case Report

A 35-year-old female patient sought dental care reporting local trauma in the region of the maxillary right lateral incisor (#12), followed by pain and recurrent fistula in the area, endodontically treated about 15 years earlier (Figure 1).



Figure 1 – Initial appearance – Fistula above tooth #12.

Clinical examination revealed slight gingival edema and presence of a fistulous tract in the vestibular region of tooth #12. A cone-beam computed tomography (CBCT) showed an extensive periapical lesion associated with external tooth and bone resorption, as well as findings compatible with longitudinal root crack (Figures 2 and 3).

Due to the poor prognosis, surgical treatment with extraction, followed by immediate implant placement and immediate loading associated with regenerative and soft-tissue thickening techniques was indicated.

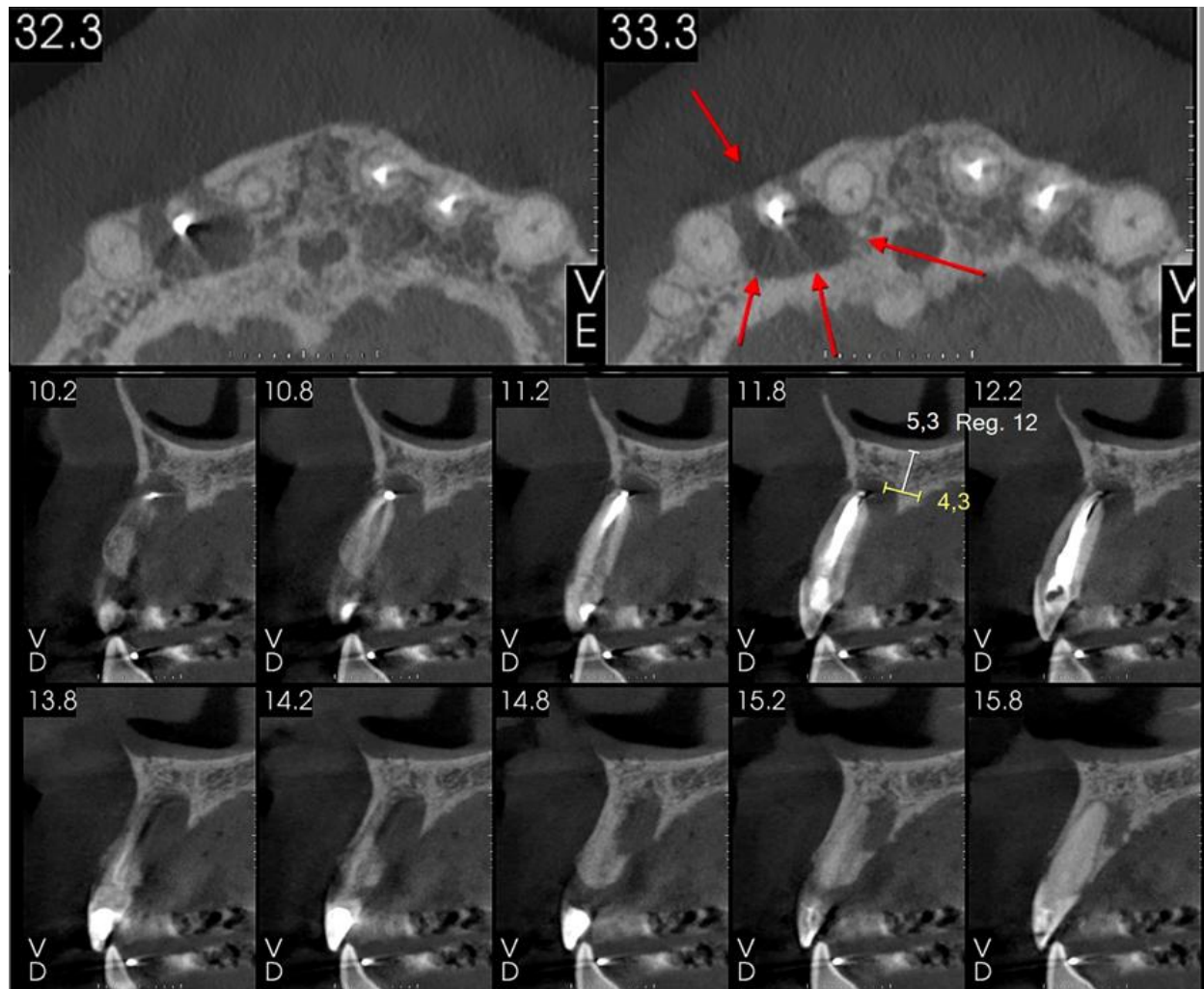


Figure 2 – CBCT – Bone and external tooth resorption of tooth #12.

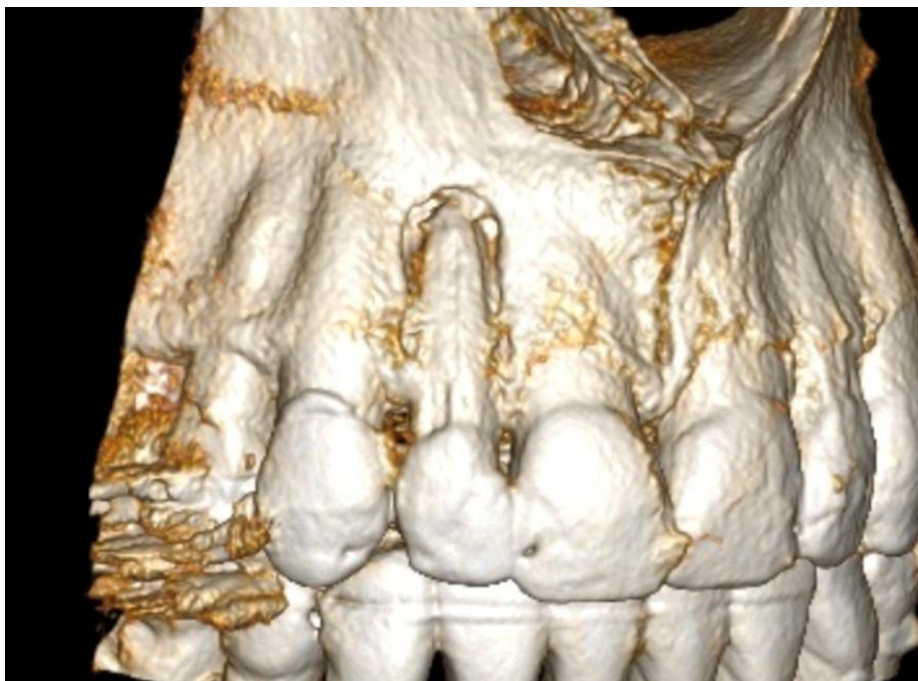


Figure 3 – 3D reconstruction – Bone resorption and Fracture image of tooth #12.

Antibiotic (Amoxicillin 500mg) therapy was prescribed one week prior to surgery to control infectious exacerbation. After intra- and extra-oral asepsis, local infiltration anesthesia with articaine 4% with epinephrine 1/100.000 was performed, followed by an incision extending from the distal of the canine (#13) to the mesial of the central incisor (#11). A full-thickness flap was raised, and the longitudinal fracture was visualized and confirmed (Figure 4).

Atraumatic extraction was performed, followed by careful curettage and abundant irrigation with sterile solution. The socket was then decontaminated with active oxygen gel (blue®m), applied topically and left for 3 minutes, followed by abundant irrigation (Figures 5 and 6).



Figure 4 – Total flap reflection – Confirmation of fracture.



Figure 5 - After tooth removal and curettage.



Figure 6 - Application of blue@m gel in the surgical socket for decontamination.

A Helix Acqua GM Neodent implant (3.5 × 16 mm) was placed with palatal positioning and bicortical anchorage (Figure 7), approximately 3 mm below the bone crest. The implant achieved 60

N insertion torque, allowing immediate loading. A universal abutment (Neodent GM 3.3x6x2.5 mm) torqued to 20 N was installed.



Figure 7 – Verification of implant positioning.

A provisional cylinder and a PMMA crown milled from previous digital scanning were used, adjusted out of occlusion to avoid contacts in maximum intercuspation and excursions (Figure 8).

The bone defect was filled with small-granulation xenograft (Cerabone®) and covered with a slow-resorption collagen membrane (Jason®) (Figures 9 and 10).

To enhance soft-tissue stability, de-epithelialized connective tissue graft harvested from the palate was positioned buccally and stabilized with sutures (Figures= 11). Suspensory and simple interrupted sutures were placed to achieve tension-free flap stabilization (Figure 12) At the end of the procedure, blue@ m gel was applied to the surgical site (Figure 13).

Postoperative prescriptions included antibiotics (Amoxicillin 500mg - 7 days), anti-inflammatories (Spidufen 600mg - 5 days), and analgesics (Dipyrone 1mg - 5 days). Healing was uneventful with complete fistula resolution and no pain. Follow-ups at 7, 21 and 60 days showed provisional stability, preserved papillae, and maintained vestibular contour (Figures 14, 15 and 16).

After 90 days, definitive metal-free prosthesis was fabricated. At 180 days, excellent soft-tissue maturation and esthetic results were observed (Figure 17).

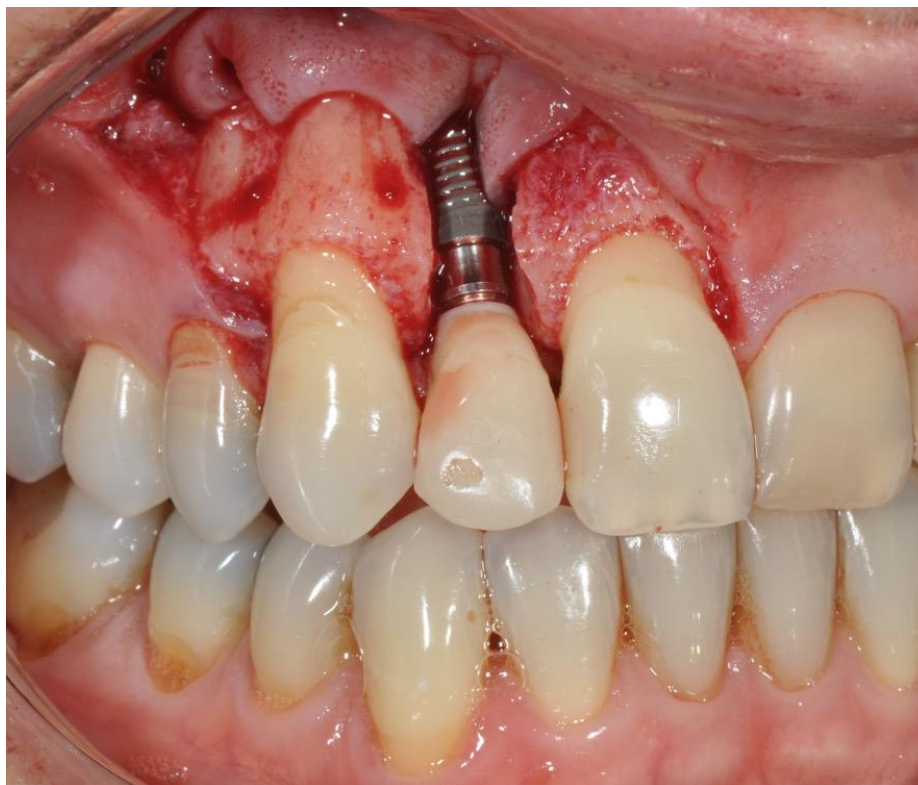


Figure 8 – Implant installed with PMMA milled provisional captured.



Figure 9 – Socket filled with xenograft.



Figure 10 – Collagen membrane adapted.



Figure 11 – Connective tissue graft positioned.



Figure 12 – Suspensory and simple interrupted sutures were placed to achieve tension-free flap stabilization.



Figure 13 –blue@m gel applied immediately postoperative.



Figure 14 – 7-day postoperative follow-up.



Figure 15 – 21-day postoperative follow-up.



Figure 16 – 60-day postoperative follow-up.



Figure 17 – 180-day follow-up after delivery of final prosthesis.

Discussion

Longitudinal root fractures associated with chronic periapical infection represent a challenging clinical scenario, often leading to tooth extraction due to the unfavorable prognosis of conservative approaches^{1,2}. In the esthetic zone, immediate implant placement has been widely advocated as a predictable strategy to preserve alveolar bone and soft-tissue architecture, provided that strict surgical and prosthetic criteria are met³⁻⁶.

In the present case, infection control was addressed through a combined systemic and local approach. Systemic antibiotic therapy with amoxicillin (500 mg, three times daily) was initiated 7 days prior to surgery and maintained for 7 days postoperatively, resulting in a total of 14 days of antimicrobial coverage. This extended regimen was selected due to the presence of a fistula, extensive periapical lesion, and longitudinal fracture, conditions that are known to increase bacterial load and risk of postoperative complications^{1,2,6}. Although immediate implant placement protocols often recommend shorter antibiotic courses, extended coverage may be justified in infected sites undergoing immediate implantation and regenerative procedures^{6,7}. Postoperative inflammation was controlled with a non-steroidal anti-inflammatory drug (ibuprofen 600 mg, every 8 hours for 5 days), following commonly accepted oral surgery protocols.

Primary implant stability is a prerequisite for immediate loading, with insertion torque values above 30–35 N·cm being generally recommended⁵⁻⁷. In this case, a torque of 60 N·cm was achieved through palatal positioning and bicortical anchorage, allowing immediate provisionalization. Subcrestal implant placement of approximately 3 mm was chosen, as evidence suggests that subcrestal positioning may reduce marginal bone remodeling and improve long-term peri-implant bone stability when combined with appropriate prosthetic management^{8-10,24,25}.

The management of the buccal bone defect using a xenogeneic bone substitute (cerabone®) in combination with a collagen membrane (Jason®) is supported by studies demonstrating predictable volumetric stability and favorable regenerative outcomes^{26,27,29}. The addition of a connective tissue graft further contributed to soft-tissue thickness and contour stability, which is particularly critical in immediate implant placement in the esthetic zone. Systematic reviews and randomized clinical trials have consistently shown superior esthetic outcomes and soft-tissue stability when connective tissue grafts are associated with immediate

implants¹⁴⁻¹⁶.

An important aspect of this case was the transoperative use of an active oxygen gel (blue®m) for socket decontamination. Active oxygen-releasing agents have demonstrated antimicrobial effects against periopathogenic bacteria and favorable biological responses in periodontal and peri-implant tissues¹⁷⁻²¹. In vitro studies have shown that blue®m gel exhibits antimicrobial activity comparable to chlorhexidine while maintaining a favorable biocompatibility profile¹⁷. Clinical reports have also described its successful use in periodontal therapy, peri-implant diseases, and complex conditions such as medication-related osteonecrosis of the jaws¹⁸⁻²¹.

It is important to note that blue®m gel is not classified as a sterile surgical material. However, it is manufactured under controlled conditions and considered microbiologically safe for clinical use when proper handling protocols are followed¹⁷⁻²¹. During transoperative application, the gel should be dispensed using sterile instruments, avoiding direct contact between the container tip and the surgical field. The use of a previously opened container may be acceptable provided that it has been stored according to the manufacturer's recommendations, remains within the expiration date, and has not been contaminated. For surgical applications, dedicating a container exclusively for operative use is advisable to minimize cross-contamination risk, a practice consistent with recommendations for adjunctive non-sterile agents used in oral surgery¹⁷⁻²¹.

The integration of systemic antimicrobial therapy, local active oxygen decontamination, immediate implant placement, regenerative procedures, connective tissue grafting, and immediate provisionalization in a single surgical stage aligns with current evidence supporting simplified protocols in the esthetic zone^{4,5,10,22-25}. Single-stage approaches reduce the number of surgical interventions, shorten treatment time, and enhance patient comfort while maintaining high success rates and favorable esthetic outcomes.

Despite the inherent limitations of a single case report and the relatively short follow-up period, the present findings are consistent with the available literature and support the use of a carefully planned single-stage protocol for the management of longitudinal root fractures associated with infection in the anterior maxilla.

Conclusion

The single-stage protocol combining active oxygen gel decontamination, immediate implant placement and loading, and simultaneous hard- and soft-tissue grafting proved to be a predictable therapeutic approach for longitudinal root fracture in the esthetic zone, allowing



infection control, primary implant stability, and preservation of peri-implant tissues, while reducing treatment time and surgical morbidity compared with conventional staged protocols.

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